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**UTILITY  
PATENT APPLICATION  
TRANSMITTAL**

(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))

Attorney Docket No. 164.1001.01

First Inventor or Application Identifier Majidi-Ahy, Reza

Title Robust Topology Wireless Communication Using Broadband Access Points

Express Mail Label No. EL 524 781 512 US

PTO

**APPLICATION ELEMENTS**

See MPEP chapter 600 concerning utility patent application contents.

1.  \* Fee Transmittal Form (e.g., PTO/SB/17)  
(Submit an original and a duplicate for fee processing)

2.  Specification [Total Pages 28]  
(preferred arrangement set forth below)  
 - Descriptive title of the Invention  
 - Cross References to Related Applications  
 - Statement Regarding Fed sponsored R & D  
 - Reference to Microfiche Appendix  
 - Background of the Invention  
 - Brief Summary of the Invention  
 - Brief Description of the Drawings (if filed)  
 - Detailed Description  
 - Claim(s)  
 - Abstract of the Disclosure

3.  Drawing(s) (35 U.S.C. 113) [Total Sheets 5]

4. Oath or Declaration [Total Pages ]  
 a.  Newly executed (original or copy)  
 b.  Copy from a prior application (37 C.F.R. § 1.63(d))  
(for continuation/divisional with Box 16 completed)  
 i.  DELETION OF INVENTOR(S)  
 Signed statement attached deleting  
 inventor(s) named in the prior application,  
 see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).

**\*NOTE FOR ITEMS 1 & 13: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).**

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5.  Microfiche Computer Program (Appendix)  
 6. Nucleotide and/or Amino Acid Sequence Submission  
(if applicable, all necessary)  
 a.  Computer Readable Copy  
 b.  Paper Copy (identical to computer copy)  
 c.  Statement verifying identity of above copies

**ACCOMPANYING APPLICATION PARTS**

7.  Assignment Papers (cover sheet & document(s))  
 8.  37 C.F.R. §3.73(b) Statement  Power of  
(when there is an assignee)  Attorney  
 9.  English Translation Document (if applicable)  
 10.  Information Disclosure Statement (IDS)/PTO-1449  Copies of IDS  
Citations  
 11.  Preliminary Amendment  
 12.  Return Receipt Postcard (MPEP 503)  
(Should be specifically itemized)  
 \* Small Entity  Statement filed in prior application,  
Statement(s)  Status still proper and desired  
(PTO/SB/09-12)  
 13.  Certified Copy of Priority Document(s)  
(if foreign priority is claimed)  
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## 16. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment:

Continuation  Divisional  Continuation-in-part (CIP) of prior application No: \_\_\_\_\_ / \_\_\_\_\_

Prior application information: Examiner \_\_\_\_\_ Group / Art Unit: \_\_\_\_\_

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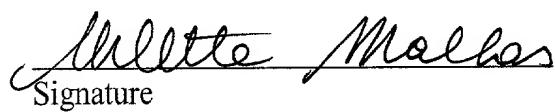
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Documents enclosed:

- Utility Patent Application Transmittal Form;
- Application Transmittal Letter;
- Specification (24) pages;
- Claims (3 ) pages;
- Abstract (1 ) pages;
- Drawings (5) pages;
- Return post card; and
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**22883**

164.1001.01

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Majidi-Ahy, Reza  
Serial No. Not Yet Assigned  
Filed: March 31, 2000  
For: Robust Technology Wireless  
Communication Using Broadband Access  
Points

Art Unit: Not Yet Assigned

Examiner: Not Yet Assigned

Tel:

1C530 U.S. PRO  
09/540674  
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**UTILITY PATENT APPLICATION**

Honorable Assistant Commissioner for Patents  
Box Patent Application  
Washington, D.C. 20231

Dear Sir or Madam:

Enclosed for filing please find the following documents:

1. Utility Patent Application Transmittal (Form SB/05);
2. Utility Patent Application for an invention entitled "Robust Technology Wireless Communication Using Broadband Access Points," filed in the name of inventor, Majidi-Ahy, Reza, assignor Aperto Networks, Inc., comprising 24 pages of specification, 3 pages of claims, 1 page of abstract, and Drawings 5 pages;
3. Return postcard; and
4. Certificate of mailing.

Respectfully submitted,

Dated: March 31, 2000



\_\_\_\_\_  
Steven A. Swernofsky  
Reg. No. 33,040

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1 This application is submitted in the name of the following inventor(s):

2

3 Inventor Citizenship Residence City and State  
4 Majidi-Ahy, Reza United States Los Altos, California

5

6 The assignee is Aperto Networks, Inc., a corporation having an office at 1637  
7 South Main Street, San Jose California.

8

9 Title of the Invention

10

11 Robust Topology Wireless Communication Using Broadband Access Points

12

13 Background of the Invention

14

15 1. *Field of the Invention*

16 This invention relates to robust topology wireless communication using access  
17 points.

18

19 Wireless communication between a sender and a receiver includes sending infor-  
20 mation using a wireless communication link, in which the sender modulates information onto a  
21 wireless communication channel (such as a frequency band reserved for wireless communication  
22 between the sender and the receiver), and the receiver demodulates that information from the  
23 wireless communication channel, so as to recover the original information.

1           One problem with known systems is that wireless communication channels are  
2           subject to several communication problems that make them relatively unreliable in comparison to  
3           wireline communication channels. Among these communication problems are interference, ran-  
4           dom or pseudo random noise, and multi-path effects. For a first example, a wireless communi-  
5           cation channel can be subject to information sent on other wireless communication channels  
6           having nearby frequencies or other similar modulation formats. For a second example, a wireless  
7           communication channel can be subject to random or pseudo random noise, such as might be gen-  
8           erated by ambient noise sources. For a third example, the information sent on a wireless com-  
9           munication channel can be reflected or refracted so as to arrive at its destination at more than one  
10           time and with varying degrees of attenuation. Of course, a most serious communication problem  
11           involves complete lack of communication between sender and receiver due to an obstruction on  
12           the line of sight path between sender and receiver.

13

14           One known method to account for these communication problems is to attempt to  
15           determine the nature of the communication problems likely to plague the wireless communica-  
16           tion channel between a selected sender and receiver, and to attempt to reverse the effects of these  
17           communication problems. For a first example, the effects of interference and noise can be allevi-  
18           ated in part by error correcting codes and other known techniques of communication using noisy  
19           channels. For a second example, multi-path effects can be alleviated in part by attempting to de-  
20           termine an impulse response of the wireless communication link, and to invert that impulse re-  
21           sponse at either the sender or the receiver, so as to cancel those multi-path effects in the signal  
22           eventually presented to the receiver.

23

1           Although these known methods generally achieve the result of improving com-  
2       munication on wireless communication links, they are subject to several drawbacks. First, these  
3       known methods are severely limited in their ability to provide wireless communication to loca-  
4       tions not reachable by point to point links, such as locations behind obstructions like buildings or  
5       mountains, or locations at nodes in an interference or reflection pattern at the selected communi-  
6       cation frequency. Second, these known methods are severely degraded with increases in interfer-  
7       ence or noise (of any kind), and can at best achieve communication capability associated with a  
8       noiseless communication link. Moreover, none of these known methods achieve the capability of  
9       solving the problem of complete lack of communication between sender and receiver due to an  
10      obstruction on the line of sight path between sender and receiver.

11  
12           Accordingly, it would be advantageous to provide a technique for wireless com-  
13 munication, such as for use in a wireless communication system, that is not subject to drawbacks  
14 of the known art.

## Summary of the Invention

18 The invention provides a method and system for robust topology wireless com-  
19 munication using access points. In a preferred embodiment, a wireless communication system  
20 includes a communication cell having a base station controller and at least one set of customer  
21 premises equipment. The customer premises equipment is disposed within a sector of the cell,  
22 and communication between the base station controller and the customer premises equipment is  
23 controlled by the base station controller is so as to prevent interference between multiple sets of  
24 customer premises equipment. When customer premises equipment is subject to relatively larger

1 amounts of interference or noise, one or more access points are disposed within the sector, so as  
2 to propagate or route communication between the base station controller and one or more sets of  
3 customer premises equipment. In aspects of the invention described herein, the access points  
4 may range in complexity from simple reflectors, to repeaters, to routing devices operative within  
5 the cell.

6

7 The invention provides an enabling technology for a wide variety of applications  
8 for wireless communication, so as to obtain substantial advantages and capabilities that are novel  
9 and non-obvious in view of the known art. Examples described below primarily relate to cellular  
10 wireless communication systems, but the invention is broadly applicable to many different types  
11 of wireless and other communication systems.

12

13 Brief Description of the Drawings

14

15 Figure 1 shows a first block diagram of a system for wireless communication us-  
16 ing robust topology.

17

18 Figure 2 shows a second block diagram of a system for wireless communication  
19 using robust topology.

20

21 Figure 3 shows a third block diagram of a system for wireless communication us-  
22 ing robust topology.

23

1       Figure 4 shows a fourth block diagram of a system for wireless communication  
2       using robust topology.  
3

4       Figure 5 shows a fifth block diagram of a system for wireless communication us-  
5       ing robust topology.  
6

7       Detailed Description of the Preferred Embodiment  
8

9       In the following description, a preferred embodiment of the invention is described  
10      with regard to preferred process steps and data structures. Embodiments of the invention can be  
11      implemented using general-purpose processors or special purpose processors operating under  
12      program control, or other circuits, adapted to particular process steps and data structures de-  
13      scribed herein. Implementation of the process steps and data structures described herein would  
14      not require undue experimentation or further invention.  
15

16      *Related Applications*  
17

18      Inventions described herein can be used in conjunction with inventions described  
19      in the following documents.  
20

- 21      •       U.S. Patent Application Serial No. 09/475,642, Express Mail Mailing No. EL524 780 018  
22      US, filed December 30, 1999, in the name of of Varma, Subir, Ngo, Khuong, Fuentes,  
23      Jean, Truong, Paul, and Majidi-Ahy, Reza, attorney docket number 164.1002.01, titled  
24      “Adaptive Link Layer for Point to Multipoint Communication System.”

1 • U.S. Patent Application Serial No. 09/475,716, Express Mail Mailing No. EL 524 780  
2 021 US, filed December 30, 1999, in the name of Majidi-Ahy, Reza, Hakim, Joseph, and  
3 Varma, Subir, attorney docket number 164.1003.01, titled "Integrated Self-Optimizing  
4 Multi-Parameter and Multi-Variable Point to MultiPoint Communication System."

6                   Each of these documents is hereby incorporated by reference as if fully set forth  
7 herein. These documents are sometimes collectively referred to herein as the "Incorporated Dis-  
8 closures."

## 10 Lexicography

12 The following terms refer or relate to aspects of the invention as described below.  
13 The descriptions of general meanings of these terms are not intended to be limiting, only illustra-  
14 tive.

16 • **access point** — in general, a device for performing message forwarding (either passively  
17 or actively) within a wireless communication cell. There is no particular requirement that  
18 an access point must be a single device; in alternative embodiments, the access points can  
19 each include a portion of a single device, a combination of multiple devices, or some hy-  
20 brid thereof. Access points are sometimes referred to herein as “broadband” access  
21 points, to indicate their generic ability to handle broadband communication instead of, or  
22 in addition to, narrowband communication.

1     • **base station controller** — in general, a device for performing coordination and control  
2       for a wireless communication cell. There is no particular requirement that the base sta-  
3       tion controller must be a single device; in alternative embodiments, the base station con-  
4       troller can include a portion of a single device, a combination of multiple devices, or  
5       some hybrid thereof.

6

7     • **cell** — in general, a region associated with a base station controller in which customer  
8       premises equipment communicate with the base station controller and in which the base  
9       station controller exercises control over communication parameters. Although in a pre-  
10       ferred embodiment, cells are each contiguous and compact, there is no particular re-  
11       quirement for either property; cells may include non-contiguous sub-regions and are not  
12       necessarily compact.

13

14     • **communication link** — in general, an element for sending information from a sender to a  
15       recipient. Although in a preferred embodiment the communication links referred to are  
16       generally wireless line of sight point-to-point communication links, there is no particular  
17       requirement that they are so restricted.

18

19     • **customer premises equipment** — in general, a device for performing communication  
20       processes and tasks at a customer location, and operating in conjunction with the base  
21       station controller within a wireless communication cell. There is no particular require-  
22       ment that the customer premises equipment must be a single device; in alternative em-  
23       bodiments, the customer premises equipment can include a portion of a single device, a  
24       combination of multiple devices, or some hybrid thereof.

1

2 • **MAC parameters** — in general, with reference to a wireless communication link, a set  
3 of characteristics or parameters relating to media access control of a communication link.  
4 For example, MAC parameters can include (a) a number of payload data bytes assigned  
5 per message, (b) a frequency of acknowledgement messages and a number of message  
6 retransmission attempts, (c) a fraction of the communication link allocated to downstream  
7 versus upstream communication, and the like.

8

9 • **physical parameters** — in general, with reference to a wireless communication link, a  
10 set of characteristics or parameters relating to physical transmission of information on a  
11 communication link. For example, physical characteristics can include (a) a symbol  
12 transmission rate, (b) a number of payload data bits assigned per symbol, (c) a number of  
13 error detection or correction bits assigned per symbol, and the like.

14

15 • **propagate or route** — in general, to forward a message from a sender toward a destination  
16 using an intermediate point, such as an intermediate reflector, repeater, or routing or  
17 switching element

18

19 • **sector** — in general, a portion of a cell that is not the entire cell. For example, a cell can  
20 be divided into multiple sectors in response to an angle of direction or a distance from the  
21 base station controller. There is no particular requirement that sectors must be disjoint;  
22 they may be overlapping.

23

- **wireless communication system** — in general, a communication system including at least one communication link that uses wireless communication techniques.
- **wireless transport layer** — in general, a set of protocols and protocol parameters for sending and receiving information using wireless transport. In a preferred embodiment, the wireless transport layer is part of a multilayer systems architecture, in which the wireless transport layer is built using a physical transport layer, and the wireless transport layer is used by a logical transport layer such as IP.

As noted above, these descriptions of general meanings of these terms are not limiting, only illustrative. Other and further applications of the invention, including these terms and concepts, would be clear to those of ordinary skill in the art after application. These other and further applications are part of the scope and spirit of and would be clear to those of ordinary skill in the art, without further invention ormentation.

## *System Context*

A system using point to multipoint wireless communication in a wireless communication system operates as part of a system in which devices coupled to a network (such as a network) send messages, route and switch messages, and receive messages. In a preferred embodiment, devices coupled to (and integrated with) the network send, route, and receive messages as sequences of packets, each of which has a header including delivery information and a payload including data. In a preferred embodiment, packet format conforms to the

1 OSI model, in which relatively higher-level protocols such as an application protocol (layer 5,  
2 such as FTP), use relatively lower-level protocols such as a transport protocol (layer 4, such as  
3 TCP), which uses a network protocol (layer 3, such as IP), which uses a media access control  
4 (MAC) protocol (layer 2), which uses a physical transport technique (layer 1). In a preferred em-  
5 bodiment, packet format conforms to the OSI model, in which relatively lower-level protocols  
6 use higher-level protocols to recover from communication difficulties.

7

8 The system for wireless communication using robust topology is described herein  
9 with regard to layer 1 and layer 2, particularly as it applies to interactions between layer 1 and  
10 layer 2 and between those layers and layer 3. However, concepts and techniques of the invention  
11 are also applicable to other layers of the OSI model. Adapting those concepts and techniques to  
12 such other layers would not require undue experimentation or further invention, and is within the  
13 scope and spirit of the invention.

14

### 15 *System Elements*

16

17 Figure 1 shows a first block diagram of a system for wireless communication us-  
18 ing robust topology.

19

20 A system 100 includes a wireless communication cell 110, a base station control-  
21 ler 120, and one or more sets of customer premises equipment 130. The system 100 also in-  
22 cludes a set of more than one sector 111 within the cell 110, a set of zero or more access points  
23 140 within each sector 111, and a set of packets 150 sent among the elements of the system 100.

24

1           The wireless communication cell 110 includes a generally hexagon-shaped region  
2 of local surface area, such as might be found in a metropolitan region. Use of generally hexagon-  
3 shaped regions is known in the art of wireless communication because they are able to tile a local  
4 region with substantially no gaps. However, although in a preferred embodiment the wireless  
5 communication cell 110 includes a generally hexagon-shaped region, there is no particular re-  
6 quirement for using that particular shape; in alternative embodiments it may be useful to provide  
7 another shape or tiling of the local surface area.

8

9           The base station controller 120 includes a processor, program and data memory,  
10 mass storage, and one or more antennas for sending or receiving information using wireless  
11 communication techniques.

12

13           Similar to the base station controller 120, each set of customer premises equip-  
14 ment 130 includes a processor, program and data memory, mass storage, and one or more anten-  
15 nas for sending or receiving information using wireless communication techniques.

16

17           Communication among devices within the wireless communication cell 110 is  
18 conducted on one-to-one basis between each set of customer premises equipment 130 and the  
19 base station controller 120. Thus, the base station controller 120 communicates with each set of  
20 customer premises equipment 130, and each set of customer premises equipment 130 communi-  
21 cates with the base station controller 120. Customer premises equipment 130 do not communi-  
22 cate directly with other customer premises equipment 130.

23

1 Communication between the base station controller 120 and each set of customer  
2 premises equipment 130 is conducted using a time division duplex technique, in which time du-  
3 ration is are divided into individual frames, each one of which includes a “downstream” portion  
4 and an “upstream” portion. Unlike existing protocols in which transmissions are controlled by  
5 the transmitting side, the base station controller 120 controls tranmissions for both upstream and  
6 downstream directions, without specific requests from the customer premises equipment 130.

7  
8        During the downstream portion of each frame, the base station controller 120  
9    transmits, thus sending information to one or more sets of customer premises equipment 130.  
10   During the upstream portion of each frame, the base station controller automatically allocates  
11   slots for upstream re-transmission. This occurs in the absence of an explicit request for a slot  
12   from the customer premises equipment 130. Particular aspects of each frame are described in the  
13   Incorporated Disclosures. Time division duplex techniques are known in the art of wireless  
14   communication.

## 16 Access Points 1

18 In a first block diagram shown in figure 1, each access point 140 includes a re-  
19 flector 141. Reflectors are known in the art of wireless communication.

21 Each packet 150 sent from the base station controller 120 to the customer premises  
22 equipment 130 can be sent line-of-sight to an access point 140, which can include a reflector  
23 141, rather than line-of-sight from the base station controller 120 to the customer premises  
24 equipment 130. The reflector 141 at the access point 140 causes the electromagnetic signal car-

1 trying the packet 150 to be reflected from a first outbound path 151 to a second outbound path  
2 152, so that the packet 150 reaches the customer premises equipment 130 in better form than us-  
3 ing a line-of-sight path between the base station controller 120 to the customer premises equip-  
4 ment 130.

5

6 Similarly, each packet 150 sent from the customer premises equipment 130 to the  
7 base station controller 120 can be sent line-of-sight to an access point 140, which can include a  
8 reflector 141, rather than line-of-sight from the customer premises equipment 130 to the base  
9 station controller 120. The reflector 141 at the access point 140 causes the electromagnetic sig-  
10 nal carrying the packet 150 to be reflected from a first inbound path 153 to a second inbound path  
11 154, so that the packet 150 reaches the base station controller 120 in better form than using a  
12 line-of-sight path between the customer premises equipment 130 to the base station controller  
13 120.

14

#### 15 *Access Points 2*

16

17 Figure 2 shows a second block diagram of a system for wireless communication  
18 using robust topology.

19

20 In a second block diagram shown in figure 2, each access point 140 includes a re-  
21 peater 142. Repeaters are known in the art of wireless communication. Each repeater 142 in-  
22 cludes a reconditioning element 143, such as including amplifiers and noise-removal circuits.

23

1                   Similar to access points 140 including reflectors 141, each packet 150 sent from  
2 the base station controller 120 to the customer premises equipment 130 can be sent line-of-sight  
3 to an access point 140, rather than line-of-sight from the base station controller 120 to the cus-  
4 tomer premises equipment 130. At the access point 140, the packet 150 is received, recondi-  
5 tioned (for example, noise is reduced and the signal is re-amplified), and resent from the access  
6 point 140 to the destination customer premises equipment 130, so that the packet 150 reaches the  
7 customer premises equipment 130 in better form than using a non-reconditioned path between  
8 the base station controller 120 and the customer premises equipment 130.

9

10                  Similarly, access points 140 using repeaters 142 can also be used for sending  
11 packets from the customer premises equipment 130 to the base station controller 120.

12

13                  Access points 140 can include both reflectors 141 and repeaters 142, and can in-  
14 clude combinations thereof, so that a packet 150 can sent line-of-sight to an access point 140,  
15 reconditioned at that access point 140 using a repeater 142 or variant thereof, and resent line-of-  
16 sight to its destination (either the base station controller 120 or the customer premises equipment  
17 130).

18

19 *Access Points 3*

20

21                  Figure 3 shows a third block diagram of a system for wireless communication us-  
22 ing robust topology.

23

1           In a third block diagram shown in figure 3, each access point 140 includes a rout-  
2       ing or switching device 143 operative within a sector 111 or within a cell 110. Routing or  
3       switching devices 143 are known in the art of communication networks.

4

5           Similar to access points 140 including reflectors 141, each packet 150 sent from  
6       the base station controller 120 to the customer premises equipment 130 can be sent line-of-sight  
7       to an access point 140, rather than line-of-sight from the base station controller 120 to the cus-  
8       tomer premises equipment 130. At the access point 140, the packet 150 is received, routed (for  
9       example, the destination customer premises equipment 130 is determined and the packet 150 is  
10      resent line-of-sight to that destination customer premises equipment 130), and resent from the  
11      access point 140 to the destination customer premises equipment 130, so that the packet 150  
12      reaches the customer premises equipment 130 in better form than using a non-routed path be-  
13      tween the base station controller 120 and the customer premises equipment 130.

14

15           Similarly, access points 140 using routing or switching devices 143 can also be  
16       used for sending packets from the customer premises equipment 130 to the base station controller  
17       120.

18

19           Access points 140 can include any one of reflectors 141, repeaters 142, and rout-  
20       ing or switching devices 143, and can include combinations thereof, so that a packet 150 can sent  
21       line-of-sight to an access point 140, routed or switched at that access point 140 using a routing or  
22       switching device 143 or variant thereof, reconditioned at that access point 140 using a repeater  
23       142 or variant thereof, and resent line-of-sight to its destination (either the base station controller  
24       120 or the customer premises equipment 130).

1

2 Moreover, routing or switching devices 143 can be used to enforce restrictions on  
3 communication between the base station controller 120 and the customer premises equipment  
4 130, using either ACL (access control list) restrictions, QoS (quality of service) restrictions, or  
5 other restrictions known in the art of communication networks. Those skilled in the art will find,  
6 after perusal of this application, that the possibility of enforcing such restrictions is part of the  
7 scope and spirit of the invention, and would not require undue experimentation or further inven-  
8 tion.

9

10 *Access Points 4*

11

12 Figure 4 shows a fourth block diagram of a system for wireless communication  
13 using robust topology.

14

15 Similar to the third block diagram shown in figure 3, in a fourth block diagram  
16 shown in figure 4, each access point 140 includes a routing or switching devices 143 operative  
17 within a sector 111 or within a cell 110.

18

19 Similar to access points 140 including routing or switching devices 143 that route  
20 or switch packets 150 directly to destination customer premises equipment 130, each packet 150  
21 sent from the base station controller 120 to the customer premises equipment 130 can be sent  
22 line-of-sight to an access point 140, rather than line-of-sight from the base station controller 120  
23 to the customer premises equipment 130. At the access point 140, the packet 150 is received,  
24 routed (for example, the destination customer premises equipment 130 is determined and the

1 packet 150 is resent line-of-sight to a second access point 140), and resent from the access point  
2 140 to that second access point 140. From the second access point 140, the packet 150 is again  
3 received, routed (for example, the destination customer premises equipment 130 is determined  
4 and the packet 150 is resent line-of-sight to the destination customer premises equipment 130),  
5 so that the packet 150 reaches the customer premises equipment 130 in better form than using a  
6 non-routed path between the base station controller 120 and the customer premises equipment  
7 130.

8

9 Similarly, access points 140 using routing or switching devices 143 can also be  
10 used for sending packets from the customer premises equipment 130 to the base station controller  
11 120, by way of intermediate access points 140 (whether including routing or switching devices  
12 143 or not).

13

#### 14 *Access Points 5*

15

16 Figure 5 shows a fifth block diagram of a system for wireless communication us-  
17 ing robust topology.

18

19 Similar to the third block diagram shown in figure 3, and similar to the fourth  
20 block diagram shown in figure 4, in a fifth block diagram shown in figure 5, each access point  
21 140 includes a routing or switching devices 143 operative within a sector 111 or within a cell  
22 110.

23

1                   Similar to access points 140 described above, those access points 140 including  
2                   routing or switching devices 143 can route or switch packets 150 among themselves, so as to  
3                   route or switch packets 150 from the base station controller 120 to a set of intermediate access  
4                   points 140 to the customer premises equipment 130. Multi-hop routing of packets 150 is known  
5                   in the art of communication networks.

6

7                   At each access point 140, the packet 150 is received, routed, and resent from the  
8                   access point 140 to a next hop. From the next hop, the process is repeated, until the packet 150 is  
9                   sent line-of-sight to the customer premises equipment 130, and thus reaches the customer prem-  
10                   ises equipment 130 in better form than using a non-routed path between the base station control-  
11                   ler 120 and the customer premises equipment 130.

12

13                   In a preferred embodiment, each access point 140 includes a routing or switching  
14                   device 143 capable of performing at least some of the following functions:

15

16           •     **IP routing** — routing or switching devices 143 can route packets 150 using IP layer  
17                   routing or switching

18

19           •     **MAC routing** — routing or switching devices 143 can route packets 150 using MAC  
20                   layer routing or switching

21

22           •     **Re-Adaptation** — routing or switching devices 143 can re-adapt packets 150, such as  
23                   breaking packets 150 into smaller units and collecting smaller units into larger packets

24                   150

1

2 • **Mini-Scheduler** — routing or switching devices 143 can include a scheduling function

3 for determining which packets 150 to give priority to in routing, re-adaptation, and

4 resending

5

6 Routing and switching devices 143 can also be configured so as to route or switch

7 only within a single sector 111 within a cell 110, or to route or switch among multiple sectors

8 111 within a cell 110.

9

10 *Access Points (Further Generality)*

11

12 Those skilled in the art will recognize, after perusal of this application, that the

13 architectures shown in the figures and described herein can be substantially generalized in several

14 ways.

15

16 First, the addition of access points 140 within a cell 110 allows the base station

17 controller 120 to add additional capacity for sending and receiving messages in conjunction with

18 customer premises equipment 130. Thus, the set of access points 140 (using reflectors 141, re-

19 peaters 142, or routing or switching devices 143) can form a mesh network in which messages

20 are routed between the base station controller 120 and customer premises equipment 130, using

21 the set of access points 140 as a communication sub-network. The communication sub-network

22 is thus simultaneously (1) a distributed network of intermediate nodes in a switching network,

23 and (2) a centralized switching system under control of the base station controller 120. For ex-

24 ample, the set of access points 140 each operate independently to perform routing and switching

1 (possibly including other aspects of routing and switching, such as scheduling, quality of service  
2 guarantees, and flow management), while the base station controller 120 controls the PHY and  
3 MAC parameters (as shown in the Incorporated Disclosures) of each of the access points 140.  
4 The base station controller 120 can control each of the access points 140 separately, or can de-  
5 termine global parameters for use within a cell 110 or sector within a cell 110.

6

7 Second, each access point 140 can perform some or all of the functions of the base  
8 station controller 120, only limited to a portion of the cell 110. Thus, within a single sector  
9 within a single cell 110, the base station controller 120 and the set of access points 140 within  
10 that sector can cooperate to control traffic, so as to form a micro-cell within the cell 110. There  
11 is no particular requirement that any one micro-cell must be entirely within a single sector; mi-  
12 cro-cells can span portions of multiple sectors or even portions of multiple cells 110. This also  
13 allows the base station controller 120 and the set of access points 140 to cooperatively maintain a  
14 multi-tier cellular architecture, with each micro-cell each controlled by an associated access point  
15 140 and cells 110 including multiple micro-cells controlled by the base station controller 120.

16

17 Third, the addition of access points 140 within a cell 110 allows the base station  
18 controller 120 to add incremental additional capacity for sending and receiving messages and  
19 controlling the flow of messages within the cell 110. This enables the wireless system to grow in  
20 incremental steps, rather than large jumps in capacity, so as to create a “pay as you grow” de-  
21 ployable system. There is no particular requirement that the addition of access points 140 within  
22 a cell 110 requires the base station controller 120 itself to have additional capacity or functional-  
23 ity.

24

1                  Fourth, there is no particular requirement that communication paths must be line  
2 of sight. Although in a preferred embodiment, most electromagnetic communication is line of  
3 sight, it is also possible for electromagnetic communication to include non line of sight compo-  
4 nents. A first example is differential penetration of barriers at different frequencies, such as  
5 buildings which pose a substantial reflection problem at a first frequency  $f_1$  but do not pose a  
6 substantial reflection problem at a second frequency  $f_2$ . A second example is refraction of elec-  
7 tromagnetic communication at known frequencies so as to obtain a non line of sight path. A  
8 third example is multipath addition resulting in communication between a first peak and a second  
9 peak in a communication standing wave. Those skilled in the art will recognize, after perusal of  
10 this application and the Incorporated Disclosures, that the base station controller 120 can ma-  
11 nipulate parameters for the PHY, MAC and other layers to improve communication with access  
12 points 140 even under non line of sight conditions.

13

14                  Fifth, the addition of access points 140 within a cell 110 presents a new opportu-  
15 nity for the base station controller 120 to control quality of service (QOS) and flow management  
16 within the cell 110. The base station controller 120 can thus control QOS between the base sta-  
17 tion controller 120 and customer premises equipment 130, either by (1) controlling specific PHY  
18 and MAC parameters for direct communication, (2) controlling specific PHY and MAC parame-  
19 ters for indirect communication using access points 140, or (3) selection of the number and loca-  
20 tion of access points 140 for indirect communication with customer premises equipment 130.  
21 Thus, for example, the base station controller 120 can choose, instead of a shortest-path strategy,  
22 a best-QOS strategy for routing messages using access points 140 to customer premises equip-  
23 ment 130.

24

1                 Sixth, those skilled in the art will recognize, after perusal of this application and  
2 the Incorporated Disclosures, that the addition of access points 140 within a cell 110 makes it  
3 easier to deploy the wireless communication system. The base station controller 120 can be lo-  
4 cated in many additional locations, as can customer premises equipment 130. Moreover, since  
5 the base station controller 120 controls the PHY, MAC and other parameters, it is easier to de-  
6 ploy the wireless communication system and obtain acceptable communication between the base  
7 station controller 120 and customer premises equipment 130 using access points 140.

8

9                 Sixth, those skilled in the art will recognize, after perusal of this application and  
10 the Incorporated Disclosures, that the addition of access points 140 within a cell 110 makes it  
11 easier to use the wireless communication system in conjunction with requirements for QOS and  
12 flow management. Since the base station controller 120 controls the PHY, MAC and other pa-  
13 rameters, it is easier to manage the wireless communication system for QOS and flow manage-  
14 ment and obtain acceptable communication between the base station controller 120 and customer  
15 premises equipment 130 using access points 140.

16

17         *Generality of the Invention*

18

19                 The invention has general applicability to various fields of use, not necessarily  
20 related to the services described above. For example, these fields of use can include one or more  
21 of, or some combination of, the following:

22

23         •         The invention is applicable to other forms of wireless communication, such as code divi-  
24 sion multiple access (CDMA, also known as spread spectrum communication), frequency

1 division multiple access (FDMA), space division multiple access (SDMA), time division  
2 multiple access (TDMA), and combinations thereof;

3

4 • The invention is applicable to wireline (that is, non-wireless) communication, in which  
5 now can be achieved from dynamically adjusting communication parameters, such as  
6 physical parameters or MAC parameters. For example, the invention can be generalized  
7 to wireline communication using modems in which equalization parameters are to be dy-  
8 namically adjusted.

9

10 • The invention is applicable to other wireless communication systems, such as satellite  
11 communication systems and (microwave tower or other) point to point transmission sys-  
12 tems.

13

14 • The invention is applicable to both fixed wireless communication systems, in which cus-  
15 tomer premises equipment do not move relative to the base station controller 120, and to  
16 mobile wireless communication systems, and which customer premises equipment move  
17 substantially relative to the base station controller 120.

18

19 Other and further applications of the invention in its most general form, will be  
20 clear to those skilled in the art after perusal of this application, and are within the scope and spirit  
21 of the invention.

22

1    *Alternative Embodiments*

2

3            Although preferred embodiments are disclosed herein, many variations are possi-  
4            ble which remain within the concept, scope, and spirit of the invention, and these variations  
5            would become clear to those skilled in the art after perusal of this application.

1                   Claims  
2

3                   1.       A method, including steps of wirelessly sending a message from a base  
4       station controller, said base station controller being capable of controlling a communication cell,  
5       to at least one customer premises equipment, wherein said steps of sending include  
6                   sending said message from a source within said cell to a first access point associ-  
7       ated with said base station controller; and  
8                   sending said message from a second access point to a destination within said cell.

9

10                  2.       A method as in claim 1, wherein said first access point includes a reflector.

11

12                  3.       A method as in claim 1, wherein said first access point includes a reflector  
13       disposed so that said step of sending from a source and said step of sending to a destination occur  
14       at a single access point

15

16                  4.       A method as in claim 1, wherein said first access point includes a repeater.

17

18                  5.       A method as in claim 1, wherein said first access point includes a repeater  
19       disposed so that said step of sending from a source and said step of sending to a destination occur  
20       at a single access point.

21

22                  6.       A method as in claim 1, wherein  
23       said first access point is located within said cell; and  
24       said second access point is located outside said cell.

1

2           7.       A method as in claim 1, wherein said step of sending from a source is at  
3       least partially wireless.

4

5           8.       A method as in claim 1, wherein said step of sending to a destination is at  
6       least partially wireless.

7

8           9.       A method as in claim 1, wherein said first access point includes a routing  
9       or switching device.

10            11.      A method as in claim 9, wherein  
12            said cell includes a plurality of sectors, and  
13            said routing or switching device is disposed so that said first access point and said  
14       second access point are in a single one of said sectors.

15

16           11.      A method as in claim 9, wherein  
17            said cell includes a plurality of sectors, and  
18            said routing or switching device is disposed so that said first access point and said  
19       second access point are in different ones of said sectors.

20

21           12.      A method as in claim 9, wherein said routing or switching device is dis-  
22       posed so that said step of sending from a source and said step of sending to a destination occur at  
23       a single access point.

24

1                   13. A method as in claim 9, wherein said routing or switching device is dis-  
2                   posed so that said step of sending from a source and said step of sending to a destination occur at  
3                   more than one access point.

1                   Abstract of the Disclosure  
2

3                   The invention provides a method and system for robust topology wireless com-  
4                   munication using access points. A wireless communication system includes a communication  
5                   cell having a base station controller and at least one set of customer premises equipment. The  
6                   customer premises equipment is disposed within a sector of the cell, and communication between  
7                   the base station controller and the customer premises equipment is controlled by the base station  
8                   controller is so as to prevent interference between multiple sets of customer premises equipment.  
9                   When customer premises equipment is subject to relatively larger amounts of multipath effect, or  
10                   interference or noise, one or more access points are disposed within the sector, so as to propagate  
11                   or route communication between the base station controller and one or more sets of customer  
12                   premises equipment. The access points may range in complexity from simple reflectors, to re-  
13                   peaters, to routing devices operative within the cell.

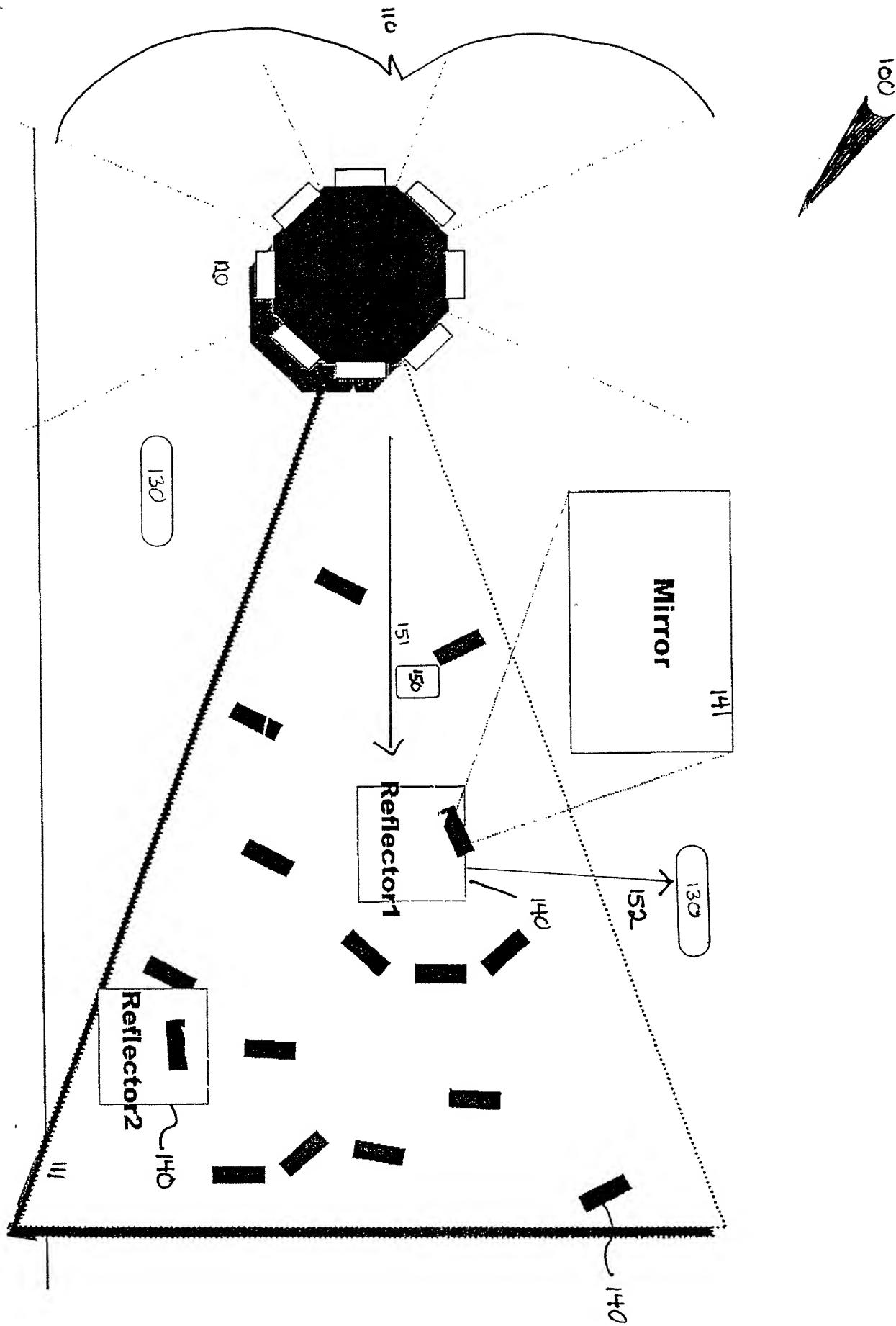
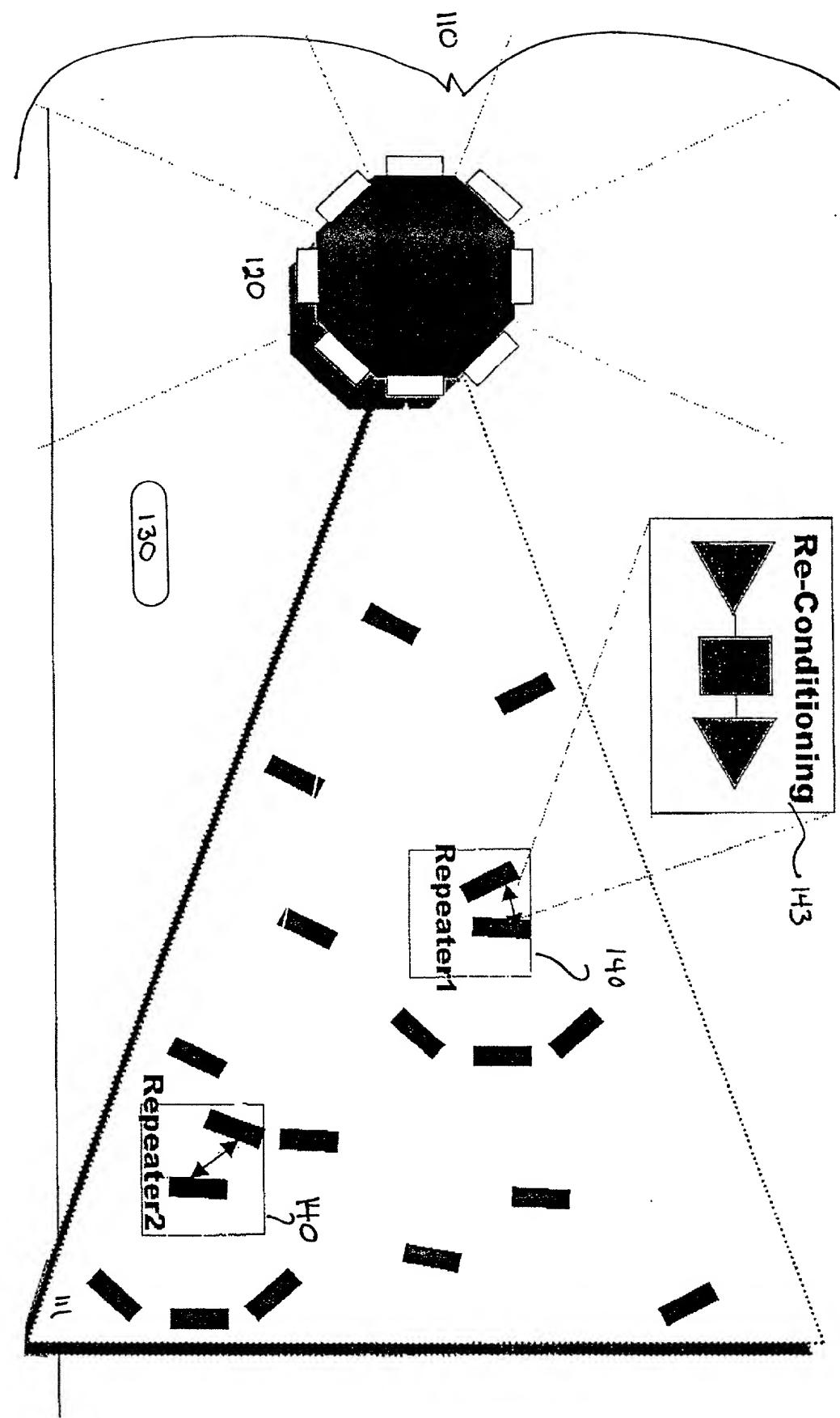
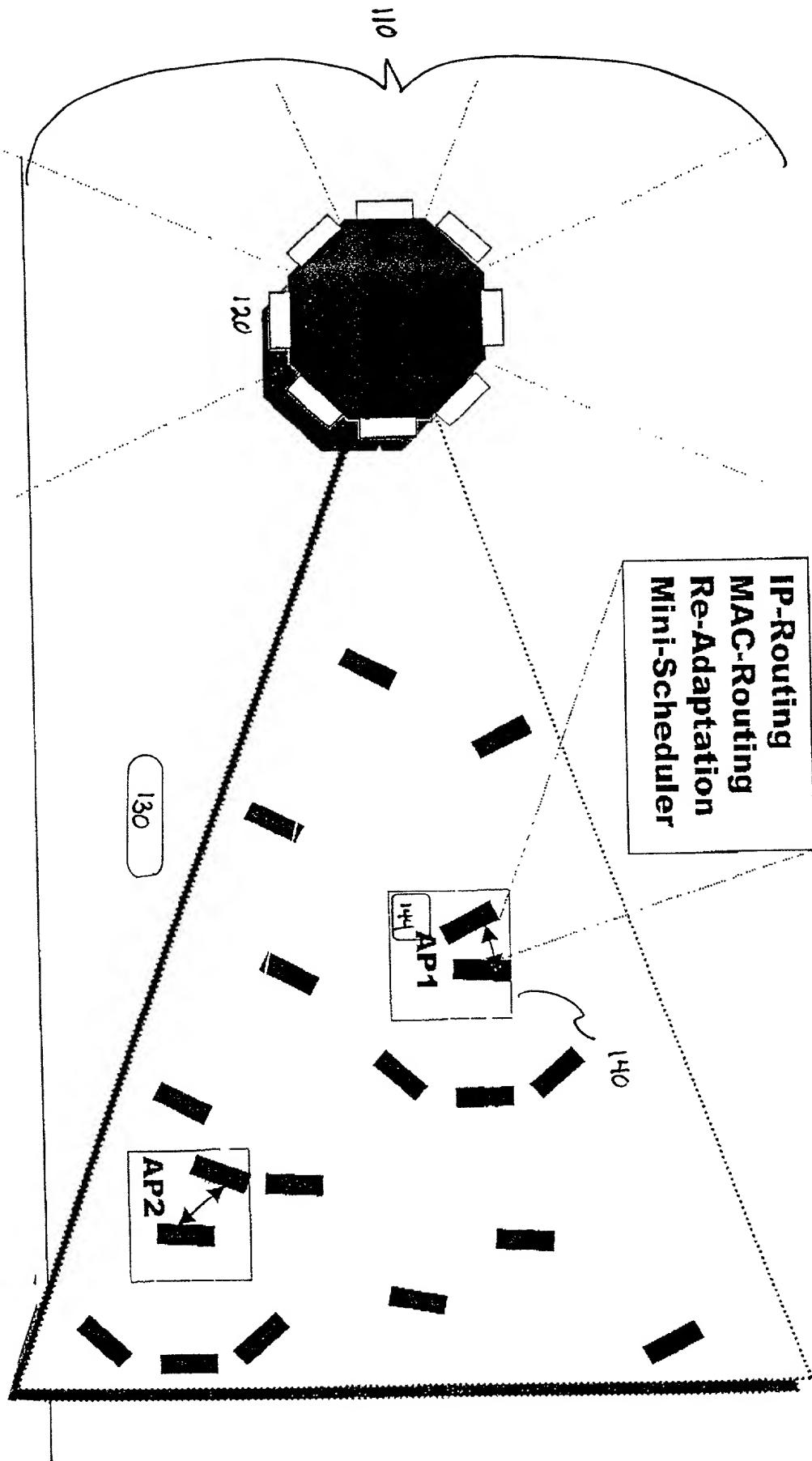


Fig. 1





161100101  
Fig 3

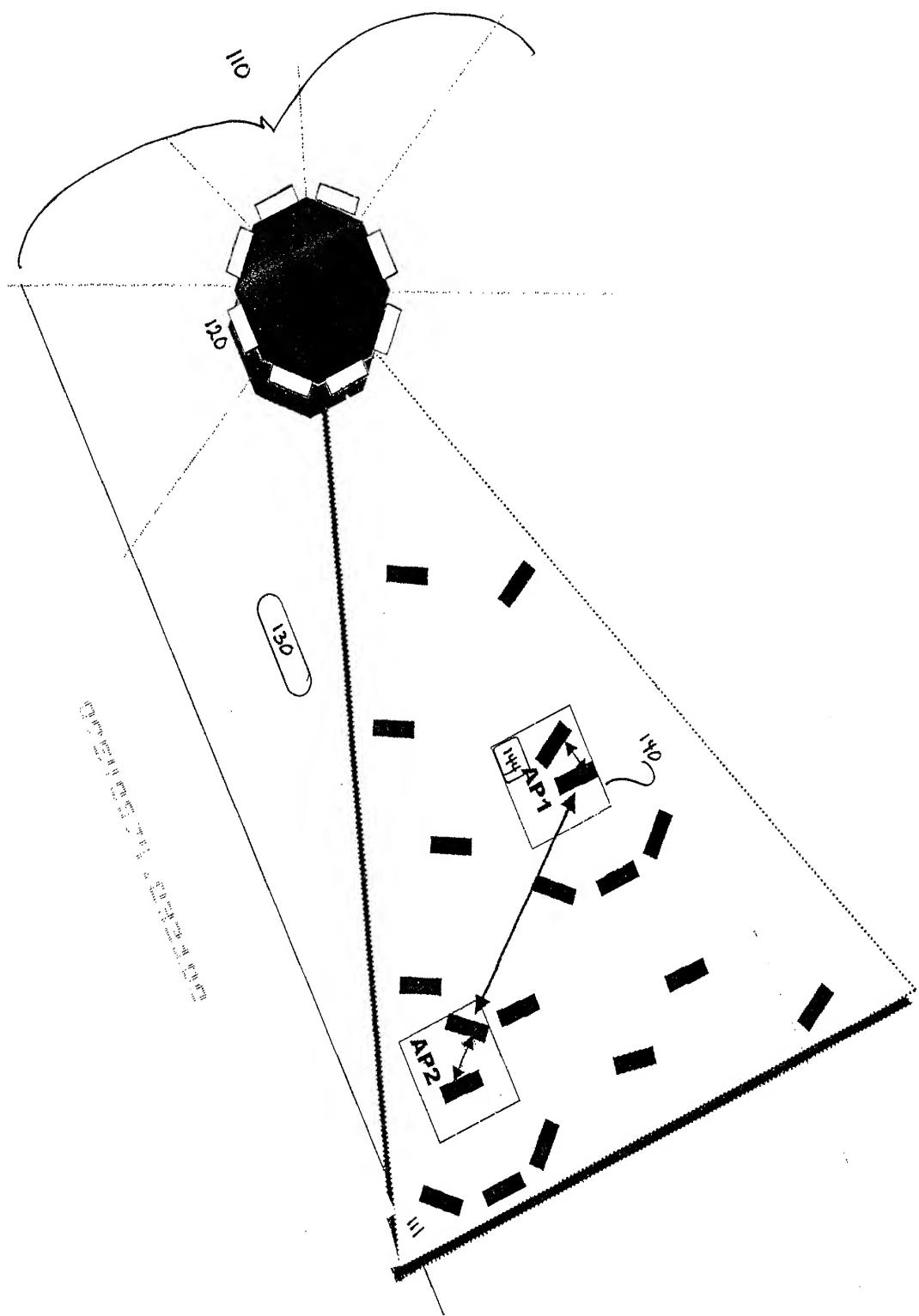


Fig 4  
150

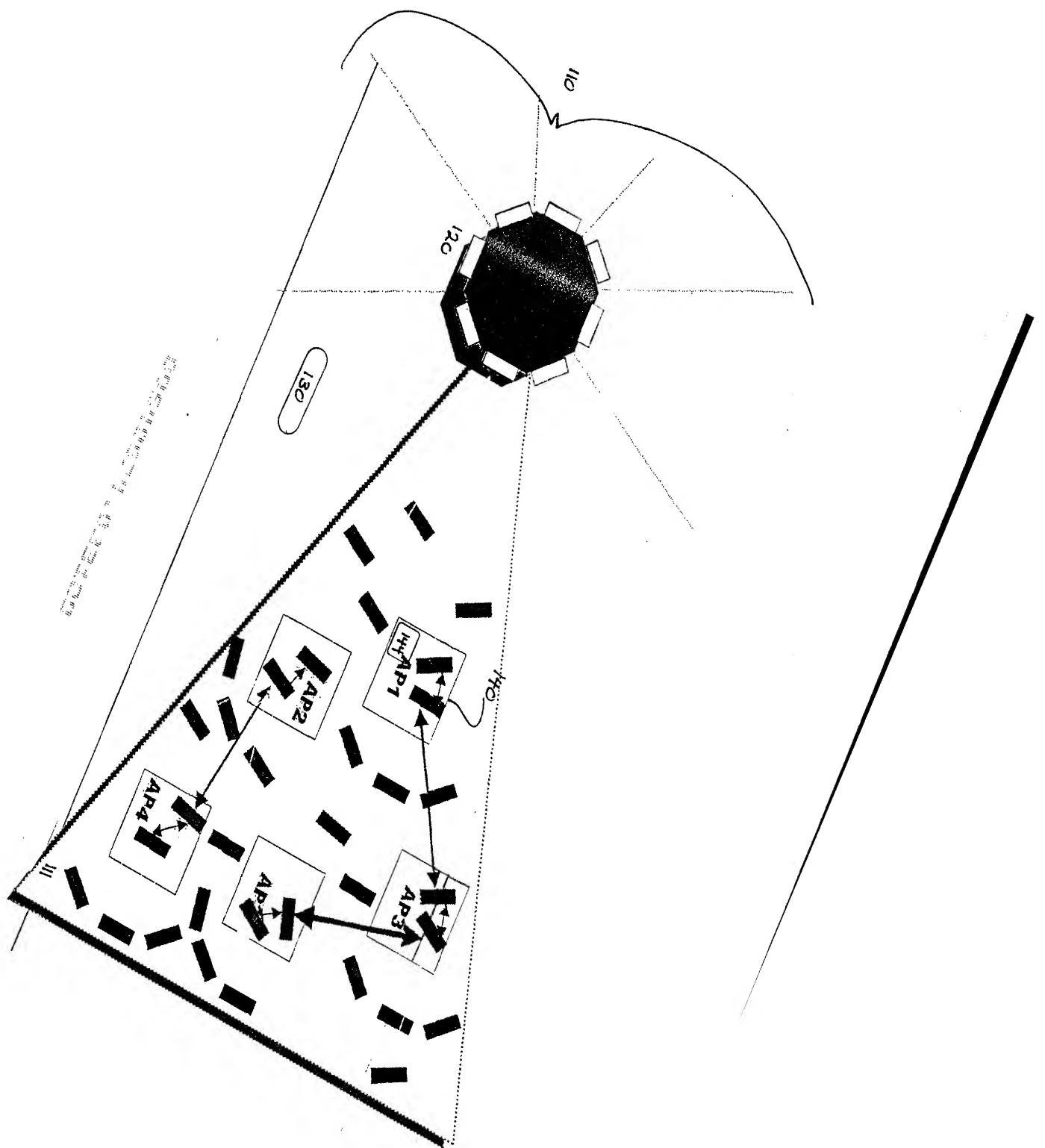


Fig 5.4.6